Check List the journal of biodiversity data
ANNOTATED LIST OF SPECIES

New departmental and noteworthy records of mammals (Mammalia, Theria) from Nicaragua

José Gabriel Martínez-Fonseca[1,2], Luis A. Trujillo[3], Erin P. Westeen[4], Fiona A. Reid[5], Charles Hood[6], Maynor A. Fernández-Mena[7], Luis E. Gutiérrez-López[8], Julio C. Molina-Loza[7], Carol L. Chambers[1]

1 *School of Forestry, Northern Arizona University, Flagstaff, Arizona, USA*
2 *Paso Pacifíco, Ventura, California, USA*
3 *Escuela de Biología, Universidad de San Carlos de Guatemala, Guatemala City, Guatemala*
4 *Department of Environmental Science, Policy, and Management and Museum of Vertebrate Zoology, University of California Berkeley, Berkeley, California, USA*
5 *Royal Ontario Museum, Ontario, Canada*
6 *Antelope Valley College, Lancaster, California, USA*
7 *Ministerio de Ambiente y Recursos Naturales, Managua, Managua, Nicaragua*
8 *Universidad Nacional Autónoma de Nicaragua-Managua, Managua, Nicaragua*

Corresponding author: *José Gabriel Martínez-Fonseca (jm3934@nau.edu)*

Abstract. Nicaragua, the largest country in Central America, is incredibly biodiverse; however, biological research has historically lagged behind neighboring countries. Recently, an increase in biological surveys and access to natural preserves has led to a better understanding of species distributions in Nicaragua and across Central America. Here, we provide new departmental records for three species of didelphid, 18 chiropterans (Phyllostomidae, Molossidae, Vespertilionidae), one geomyid, and one mustelid from 21 sites across the country. This work underscores the need for additional sampling across Nicaragua to fill gaps in the known distribution of many species. This information can facilitate or inform conservation actions in established and proposed preserves in Nicaragua.

Key words. Central America, Chiroptera, Didelphidae, distribution records, Geomyidae, Mustelidae, range extension

Martínez-Fonseca JG, Trujillo LA, Westeen EP, Reid FA, Hood C, Fernández-Mena MA, Gutiérrez-López LE, Molina-Loza JC, Chambers CL (2024) New departmental and noteworthy records of mammals (Mammalia, Theria) from Nicaragua. Check List 20 (3): 706–720. https://doi.org/10.15560/20.3.706

INTRODUCTION

Nicaragua is the largest country in Central America by area and although the first collecting expeditions for mammals were conducted in the early 19th century (Medina-Fitoria and Martínez-Fonseca 2019), the distribution and occurrence of many species in the country are not well known. Political instability and other socioeconomic conditions slowed research within the country in the last third of the 20th century (Medina-Fitoria and Saldaña 2014). However, in the last 20 years, knowledge of mammalian occurrence, distribution, and taxonomy within the country has increased. As an example, the number of bat species known in the country has risen from 86 in 1986 to 111 in 2020 (Jones and Owen 1986; Martínez-Fonseca et al. 2020). Research, both domestically and from international researchers, has steadily increased in the Nicaraguan Pacific, Caribbean Lowlands, and Northern Highlands regions, which has resulted in the first verifiable records of species such as *Diclidurus albus* Wied-Neuwied, 1820 and *Leptonycteris yerbabuenae* Martinez & Villa, 1940 (Loza et al. 2018; Saldaña Tapia et al. 2020). However, there is still a lack of documentation and scientific publications from the Caribbean Northeast region (Araque Pérez 2023).

The last checklist for mammals of Nicaragua was by Medina-Fitoria and Saldaña Tapia (2012) but lacked distribution information. For many years Reid (2009) has been the only reference available for mammalian distribution information in the country. Martínez-Fonseca et al. (2020) provided an updated checklist to the bats of Nicaragua, including occurrence data, but did not provide specific locality information (e.g., coordinates) for additional records.

Here, we provide specific location information in Nicaragua to fill gaps in the distributions of 23 mammal species of the families Didelphidae, Phyllostomidae, Molossidae, Vespertilionidae, Geomyidae, and Mustelidae. This includes many species known from only a handful of individuals and localities. Additionally, we provide associated morphometric (forearm length and weight) and ecological data for each record.

OPEN ACCESS

Academic editor: Filipe Gudinho
Received: 3 January 2024
Accepted: 17 May 2024
Published: 13 June 2024

Copyright © The authors. This is an open-access article distributed under terms of the Creative Commons Attribution License (Attribution 4.0 International – CC BY 4.0)

STUDY AREA

Our study spans the three bioregions of Nicaragua (Pacific Lowlands, Central Highlands, Caribbean Lowlands; Figure 1). Administratively, Nicaragua is composed of 15 departments, of which we visited seven — Carazo, Granada, and León in the Pacific; Estelí, Jinotega, and Nueva Segovia in the Central Highlands; and Rio San Juan in the Caribbean Lowlands. Additionally, we visited the two autonomous regions located in the Caribbean (Región Autónoma Costa Caribe Norte and Región Autónoma Costa Caribe Sur).

Precipitation patterns in Nicaragua decrease in an east to west gradient due to high elevations in the central region, creating a rain shadow effect on the west side of the country (Sunyer 2009). Precipitation in the Pacific Lowlands ranges between 1,000 and 2,000 mm annually (Incer 1973). In contrast, the Caribbean Lowlands reach up to 6,000 mm of annual precipitation in the southeastern corner (Incer 1973).

Most of our study sites were within protected areas, both privately and state owned (e.g., Reserva Silvestre Privada Escameca Grande and El Jaguar). Two additional localities correspond to areas surveyed for various development projects (e.g., Puente Rio Wawa and Aguazarca).

METHODS

All mammals were captured and identified between June 2013 and February 2023 using a combination of mist nets of different lengths (6, 9, 12, 18 m; Avinet Research Supplies, NY, USA) set at ground level or using triple-high net setups. Mist nets were set across natural flyways such as riverbeds, creeks, and forest openings, as well as water sources, following methodology from Kunz and Parsons (2009). In general, nets were opened just before sunset (~ 17:30 h) and remained open for about 6 hours.

Bats were removed from mist nets and morphometric data were collected to confirm identification. Main measurements included forearm (FA) in millimeters using a wing ruler (Avinet Inc. USA) and mass in grams (g) using analog scales (PESOLA Präzisionswaagen AG, Switzerland). Mammals were photographed to confirm species identity with matching descriptions from literature. Coordinates for each location were recorded in decimal degrees using the datum WGS84 with handheld Garmin 62 or 64st Global Positioning System units.

For marsupials, rodents, and mustelids, we visually observed the animals and confirmed identification via photography. In some cases, animals were captured by hand with leather gloves. Photographic records in this paper include field marks that allow identification to species. These opportunistic sightings occurred while scouting for bat netting locations. Identification of all animals was conducted in the field using field keys and notes from Reid (2009), Medina-Fitoria (2014), and York et al. (2019). Nomenclature and taxonomic order were based on Burgin et al. (2018), Simmons and Cirranello (2023), Martínez-Fonseca et al. (2020), and Ramírez-Fernández et al. (2023).

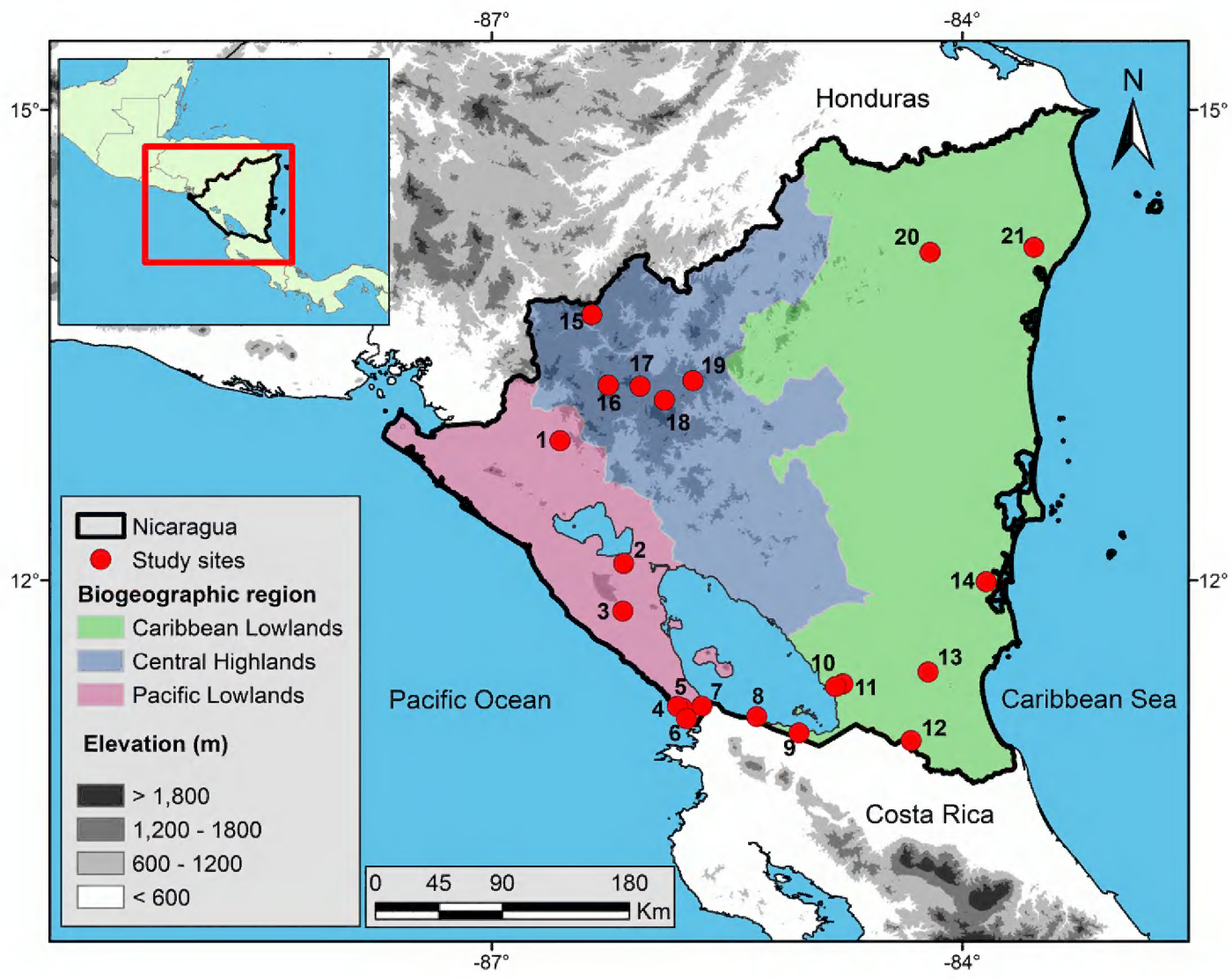

Figure 1. Study sites in Nicaragua. The three biogeographic regions are shown from left to right: Pacific Lowlands, Central Highlands; Caribbean Lowlands. 1 = El Sauce; 2 = Malacatoya; 3 = Santa Teresa City and Barrio Marlon Alvarado; 4 = Escamequita River; 5 = Reserva Silvestre Privada Escameca Grande; 6 = El Ostional; 7 = Rio Ostayo; 8 = Sardina River; 9 = Refugio Los Guatuzos; 10 = El Arrozal; 11 = El Tule; 12 = Refugio Bartola; 13 = Aguazarca; 14 = Finca San Francisco de Asís; 15 = Mogotón; 16 = La Soñada; 17 = Reserva Silvestre Privada El Jaguar; 18 = La Bastilla Ecolodge; 19 = Centro para el Entendimiento con la Naturaleza; 20 = Finca Cacao Oro; 21 = Puente Rio Wawa. Inset map shows Nicaragua's location within Central America.

Animals were handled under permits from the Nicaraguan Ministerio de Ambiente y Recursos Naturales (MARENA) No. 015-122011; DGB-IC-058-2017; DGPNB-IC-025-2018; DGPNB-090622-P2491-0; DGPNB-050723-P3347-0. We handled animals following the guidelines of the American Society of Mammalogists (Sikes and the Animal Care and Use Committee of the American Society of Mammalogists 2016) and with approval of the Northern Arizona University Institutional Animal Care and Use Committee. After handling, all animals were released unharmed.

New distribution records were evaluated from museum specimen localities available in the Global Biodiversity Information Facility (GBIF.org). The data search in GBIF was conducted using: "Species = XXXX", "Basis of record = Preserved specimens", "Location = Including coordinates" and "Country or Area = Nicaragua" (GBIF 2023). For bats, we also referred to the localities provided by the updated checklist of bats of Nicaragua by Martínez-Fonseca et al. (2020). Species accounts were sorted by family in taxonomical order following Reid (2009) and then alphabetically by genera. In addition, we referenced relevant scientific publications for each account.

RESULTS

We report noteworthy records of 23 species of mammals from the families Didelphidae (3), Phyllostomidae (9), Molossidae (3), Vespertilionidae (6), Geomyidae (1), and Mustelidae (1). These records correspond to sampling conducted in 21 sites across the country.

Class Mammalia
Subclass Theria
Clade Metatheria
Order Didelphimorphia
Family Didelphidae

***Chironectes minimus* (Zimmermann, 1780)**
Figure 2A

New records. NICARAGUA – Dept. León • El Sauce; 12.8884; −086.5649; elev. 144 m; 10.VII.2014; FAR, JGMF, LEGL obs.; 19:54 foraging along a small stream ~1.5 m wide and 0.4 m deep; 1♀ – Dept. Rio San Juan • Refugio Bartola; 10.9752; −084.3273; elev. 51 m; 03.I.2013; AMF, FAR, JGMF obs.; around 22:00 foraging along the Bartola River; 1♂.

Identification. Our observations were easily confirmed as this species is identified by the presence of a marsupial pouch present in both sexes, webbed hind feet, and banded pattern on the dorsum (Reid 2009).

Distribution. Our records were the first for their respective departments and the individual from León represents the first record from the northern Pacific bioregion of Nicaragua (Medina-Fitoria and Martínez-Fonseca 2021; GBIF.Org 2023).

Remarks. Both individuals were caught by hand when found foraging and diving in rocky river areas.

***Marmosa nicaraguae* Thomas, 1905**
Figure 2B

New record. NICARAGUA – Dept. Jinotega • San Rafael del Norte; Reserva Silvestre Privada El Jaguar; 13.2356, −086.0539; elev. 1,276 m; 07.II.2023; LEGL, JGMF, MAFM obs.; 23:50 moving on rafter roof of a cabin where a nest-like structure of 40 cm diameter made of dry leaves was also observed, presumably built by this animal; 1♂.

Identification. The identification of our individual was based on several characteristics noticeable in the photograph. First, the presence of a dark mask that did not extend to the base of the ear; this separates them from both species of *Didelphis* L., 1758 (which lack dark masks) and from *Marmosa mexicana* Merriam, 1897 (with a mask that extends to the base of ears; Reid 2009). Second, our individual was larger in size than the other two species of mouse opossums known to occur in Nicaragua (*M. mexicana* Merriam, 1897 and *M. zeledoni* Goldman, 1911). Third, the hairy base of the tail and having over two-thirds of white skin towards the tail tip is a feature not shared with other marsupials in the country (Reid 2009).

Remarks. This species is known in Nicaragua from four specimens and was, until recently, classified as *Micoureus alstoni* J.A. Allen, 1900 (Voss et al. 2021; Ramírez-Fernández et al. 2023). To our knowledge, this is the first photograph of a live individual of this species in Nicaragua.

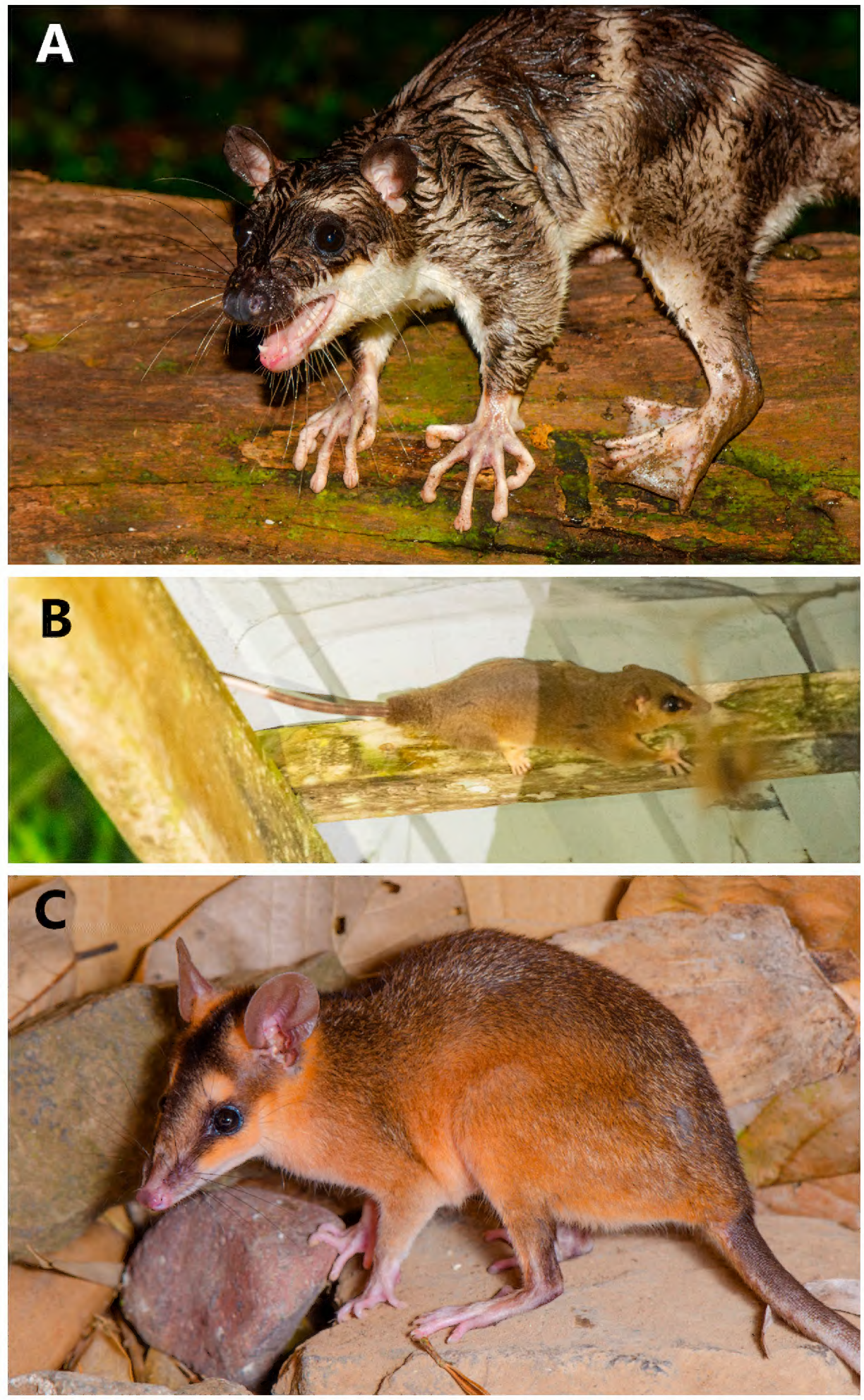

Figure 2. Noteworthy records of Didelphidae. **A.** *Chironectes minimus* (Zimmermann, 1780) from El Sauce. **B.** *Marmosa nicaraguae* Thomas, 1905 from Reserva Silvestre Privada El Jaguar. **C.** *Metachirus myosuros* (É. Geoffroy, 1803) from Macizo Peñas Blancas.

***Metachirus myosuros* (É. Geoffroy, 1803)**
Figure 2C

New record. NICARAGUA – DEPT. JINOTEGA • Macizo Peñas Blancas, Centro para el Entendimiento con la Naturaleza; 13.2714; −085.7177; elev. 1,043 m; 25.III.2014; JGMF, FAR obs.; caught by hand around 20:30 while moving along a small stream that crossed the road; 1♀.

Identification. Our identification of this opossum was made by the distinctive dark-brown face with a narrow and dark stripe from forehead to nape. It had dull-brown upper parts and pale-yellow underparts. Markings above the eyes are only shared with the gray four-eyed opossum (*Philander melanurus* (Thomas, 1899)) which is a more common and significantly larger species (Reid 2009; Ramírez-Fernández et al. 2023). The individual was carrying nine neonates in its marsupial pouch.

Remarks. Currently, no records of this species are available in GBIF. Reid (2009) describes the species distribution as over most of the southeastern Caribbean lowlands of Nicaragua and a disconnected population in southern Mexico. Our record is the first one in the Nicaragua highlands bioregion and the first for the Department of Jinotega. Until recently, Central American populations of this species were included under *M. nudicaudatus* É. Geoffroy, 1803 (Voss et al. 2019; Voss 2022; Trujillo and Escobar-Anleu 2023).

Clade Eutheria
Order Chiroptera
Family Phyllostomidae

***Diaemus youngii* (Jentink, 1893)**
Figure 3A

New records. NICARAGUA – **Dept. Rivas** • Rio Ostayo; 11.1956, −085.6606; elev. 136 m; AMF, CLC, JGMF obs.; FA 60 mm; 52 g; 27.V.2015; 1♀ • Same locality; FA 56 mm; 62 g; 03.VI.2016; AMF, CLC, JGMF obs.; 1♀ • Same locality; FA 59 mm; 49 g; 03.VI.2016; AMF, CLC, JGMF obs.; 1♀ • Same locality; 04.VI.2016; AMF, CLC, JGMF obs.; FA 59 mm; 55 g; 1♂.

Identification. Our individuals were easily recognizable from other vampire bat species (Desmodontinae) by the sparsely furred legs, a single thumb pad, small eyes, and white wing tips (Reid 2009; York et al. 2019). *Diphylla ecaudata* Spix, 1823 has thickly furred legs, very large eyes, and lacks white wing tips (Reid 2009). Our individual was easily separated from *Desmodus rotundus* (Geoffroy, 1810) which is by far the most common of the three species, because *D. rotundus* (Geoffroy, 1810) lacks white wing tips and has thumbs with two pads instead of one.

Remarks. The white-winged vampire bat is the rarest species of true vampire bats. Very few records of this species are known from the country, despite its distribution depicted as throughout Nicaragua (Baker and Knox Jones 1975; Greenbaum and Knox Jones 1978; Medina-Fitoria 2014).

***Phylloderma stenops* Peters, 1885**
Figure 3B

New records. NICARAGUA – **Dept. Rivas** • Rio Ostayo; 11.1955, −085.6606; elev. 136 m; 27.V.2015; AMF, CLC, JGMF obs.; FA 85 mm; 74 g; 1♂, scrotal male • Same locality; 27.V.2015; AMF, CLC, JGMF obs.; FA 80 mm; 93 g; 1♀, gravid female • Reserva Silvestre Privada Escameca Grande; 11.1831, −085.7851; elev. 31 m; 6.II.2016; FAR, JGMF, LEGL obs.; FA 86 mm; 1♂.

Identification. Individuals were readily distinguishable from other Phyllostominae species due to their relatively large size with forearm length among the largest of Neotropical bats. Other distinctive characteristics are the pink facial skin, a noseleaf fused to the upper lip, and white wingtips (Reid 2009). The pale-faced bat closely resembles species within the genus *Phyllostomus* Lacépède, 1799, however, *P. stenops* Peters, 1885 can be differentiated by the presence of three lower premolars, in contrast to the two lower premolars observed in the genus *Phyllostomus* Lacépède, 1799 (Martínez-Cerón et al. 2019).

Remarks. The pale-faced bat was captured in Nicaragua for the first time in the Rivas Department in 2011 with a second record obtained at Refugio Bartola, Rio San Juan Department in 2012 (Medina-Fitoria et al. 2015). The individual from Escameca Grande represents an extension range of ca. 15 km to the west and the first record of the species in the Lowland Dry Forest of the coastal Pacific region of Nicaragua.

***Vampyrum spectrum* (Linnaeus, 1758)**
Figure 3C

New records. NICARAGUA – **Dept. Rio San Juan** • El Arrozal; 11.3193, -084.8091; elev. 48 m; 3.IV.2014; JGMF obs.; FA 107 mm; 180 g; 1♂ • Refugio de Vida Silvestre Los Guatuzos; 11.0253, −085.04137; elev. 37 m; 9.II.2015; FAR; JGMF obs.; 1♂ – **Dept. Rivas** • Escamequita River; 11.19245, −085.81643; elev. 14 m; 2.VII.2015; FAR, JGMF obs.; 1♂ • Escameca Grande; 11.18318, −085.78512; elev. 31 m; 22.III.2016; JGMF, LEGL obs.; FA 111 mm; 1♂ • Same locality and date; FA 107 mm; 1♀.

Identification. Our individuals were easily identifiable from other species because of their large size with forearms >100 mm (Reid 2009). Their large size in combination with presence of four lower incisors, absence of a tail, and black wing tips differentiates the captured individuals from other members of the Phyllostominae (York et al. 2019).

Distribution. The great false vampire bat is an elusive species and the largest bat in the Americas (Reid 2009). It was previously known from only five individuals at four localities in Nicaragua (Allen 1910; Medina-Fitoria et al. 2010; Medina-Fitoria 2014; Martínez-Fonseca et al. 2022). Both of our Rio San Juan localities are the eastern and southernmost localities for the species in Nicaragua. The individual from Los Guatuzos was caught in a high net set on a canopy walkway about 10 m above ground but under the tree canopy. All other individuals were caught on single nets over natural ponds on otherwise mostly dry riverbeds.

Figure 3. Noteworthy records of Phyllostomidae and Molossidae. **A.** *Diaemus youngii* (Jentink, 1893) from Rio Ostayo. **B.** *Phylloderma stenops* Peters, 1885 from Rio Ostayo. **C.** *Vampyrum spectrum* (Linnaeus, 1758) from Refugio de Vida Silvestre Los Guatuzos. **D.** *Hylonycteris underwoodi* Thomas, 1903 from Aguazarca. **E.** *Lichonycteris obscura* Thomas, 1895 from Aguazarca. **F.** *Glyphonycteris sylvestris* Thomas 1896 from La Bastilla Ecolodge. **G.** *Ectophylla alba* **H.** Allen, 1892 from Aguazarca. **H.** *Enchisthenes hartii* (Thomas, 1892) from La Soñada. **I.** *Vampyrodes major* G.M. Allen, 1908 from Reserva Silvestre Privada El Jaguar. **J.** *Eumops ferox* (Gundlach, 1861) from El Ostional. **K.** *Eumops underwoodi* Goodwin, 1940 from El Ostional. **L.** *Promops centralis* Thomas, 1915 from Barrio Marlon Alvarado.

***Hylonycteris underwoodi* Thomas, 1903**

Figure 3D

New record. NICARAGUA – Región Autónoma Costa Caribe Sur • Aguazarca; 11.4126, −084.2179; elev. 87 m; 15.IV.2014; JCLM, JGMF obs.; FA 34 mm; 11 g; captured on mist nets extending from ground level to 2.7 m in a remnant forest patch within an area that had been cleared for pasture in the last 3 years; 1♂.

Identification. Underwood's long-tongued bat is easily distinguishable by its small size, dark coloration,

well-haired base of its forearms, and the lower jaw extending noticeably beyond the upper jaw (Jones and Homan 1974; Reid 2009). One of the most similar species is *Lichonycteris obscura* Thomas, 1895, which differs in wing placement. *Hylonycteris underwoodi* Thomas, 1903 has wings attached at the ankles, while *L. obscura* Thomas, 1895 has wings attached to the feet (Reid 2009).

Remarks. This rare nectar bat is known in Nicaragua from "few localities" (Medina-Fitoria 2014).

***Linchonycteris obscura* Thomas, 1895**
Figure 3E

New records. NICARAGUA – Región Autónoma Costa Caribe Sur • Municipio de Bluefields; Aguazarca; 11.4126, −084.2179; elev. 87 m; 15.IV.2014; JCLM, JGMF obs.; FA 36 mm; 9 g; captured in mist nets extending from ground level to 2.7 m aboveground in a remnant forest patch within an area that had been cleared for pasture in the last 3 years; 1♂ • Same locality; Municipio de Bluefields; Finca San Francisco de Asís; 11.9895; -083.84808; elev. 17 m; 16.I.2023; JGMF, LEGL, MAFM obs.; 18:20; 1♂.

Identification. Our individuals were distinguishable by their small size and tricolored hair, with dark base and tips (Zamora-Gutierrez and Ortega 2020). One of the most similar species is *H. underwoodi* Thomas, 1903, from which it can be distinguished by a lower jaw that extends just beyond the upper jaw and wings attached to the feet, near the base of the toes (Reid 2009).

Remarks. This species was historically recorded in several sites in Nicaragua, but there have been very few records in recent years (Medina-Fitoria 2014).

***Glyphonycteris sylvestris* Thomas 1896**
Figure 3F

New record. NICARAGUA – Dept. Jinotega • La Bastilla Ecolodge; 13.1477, −085.8991; elev. 1,115 m; 15.XII.2017; CH, JGMF obs.; 21:45 captured in a mist net set over a stream with fast moving water; FA 42 mm; 1♂.

Identification. Tricolored big-eared bats share many similarities with species of the genus *Carollia* Gray, 1838 but they can be distinguished by the presence of a V-shaped pad in the central portion of their chin. Another similar species is *Trinycteris nicefori* Sanborn, 1949, from which they can be distinguished by a longer calcar and tricolored dorsal hair (Reid 2009).

Distribution. This record represents the third for the country, and an increase in elevation recorded for this species of about 315 m in Central America (Reid 2009; Medina-Fitoria 2014; Martínez-Fonseca et al. 2020).

***Ectophylla alba* H. Allen, 1892**
Figure 3G

New records. NICARAGUA – Región Autónoma Costa Caribe Sur • Aguazarca; 11.4126, −084.2179; elev. 87 m; 16.IV.2014; FA 30 mm; 6 g; captured in mist nets extending from ground level to 2.7 m in a remnant forest patch within an area that had been cleared for pasture in the last 3 years; JCLM; JGMF; 2♀. – Dept. Rivas • Rio Sardina River; near El Abuelo; 11.1288, −085.3106; elev. 52 m; 5.IV.2011; AMF obs.; FA 27 mm; 5 g; 1♀.

Identification. Our individuals were notably small, displaying a pure white color in the head and upper body, a pale gray shade on the lower belly and rump, and vibrant yellow ears and noseleaf. No other phyllostomid species exhibits a predominantly white color (Timm 1982; Reid 2009).

Remarks. The Honduran white bat is known to range from Honduras to Panama and is expected to occur throughout the Caribbean Lowlands (Reid 2009), but there are only a few formal records in Nicaragua (Martínez-Fonseca et al. 2020).

***Enchisthenes hartii* (Thomas, 1892)**
Figure 3H

New records. NICARAGUA – Dept. Estelí • Reserva Natural Miraflor-Moropotente; La Soñada; 13.243; −086.2578; elev. 1,407 m; 08.XI.2014; FAR, JGMF obs.; 1♂ – Dept. Jinotega • La Bastilla Ecolodge; 13.1477, −085.8991; elev. 1,115 m; 15.XII.2017; CH, JGMF obs.; 21:45 capture in a mist net set over a stream with fast moving water; 1♂ • Reserva Silvestre Privada El Jaguar; 13.2341, −086.0532; elev. 1,275 m; 13.XII.2017; CH, JGMF obs.; 23:58; 1♂.

Identification. The small size, horseshoe-shaped noseleaf fused below the nostrils, and distinct dark chocolate coloration of our individuals allowed for easy differentiation from other members in the Stenodermatinae subfamily (Arroyo-Cabrales and Owen 1997).

Remarks. *Enchisthenes hartii* (Thomas, 1892) is a rare species and in Nicaragua has only been found in the Central Highlands near the continental divide in the Estelí and Matagalpa departments (Martínez-Fonseca et al. 2020).

***Vampyrodes major* G.M. Allen, 1908**
Figure 3I

New record. NICARAGUA – **Dept. Jinotega** • San Rafael del Norte; Reserva Silvestre Privada El Jaguar; 13.2356, −086.0539; elev. 1,276 m; 14.XII.2017; CH, JGMF obs.; 20:50; FA 53 mm; 41 g; 1♂.

Identification. The individual was easily distinguished by its relatively large size, sandy-brown coloration, prominent white back stripe from crown of head to rump, and prominent facial stripes (Reid 2009). The uropatagium in our individual was also short and had a clear fringe of white hairs, a feature that in Nicaragua is only shared by *Platyrrhinus helleri* Peters, 1866 but which has a much smaller size (forearm <41 mm; Reid 2009).

Remarks. This species has only been reported in Nicaragua from a few individuals in the lowlands of the Rio San Juan Department, and higher elevations in Boaco, Chontales, Jinotega, and Matagalpa (Medina-Fitoria 2014). However, no specific localities were previously available. Populations of this species were, until recently, included in *V. caraccioli* Thomas, 1889 (Velazco and Simmons 2011; Martínez-Fonseca et al. 2020)

Family Molossidae

***Eumops ferox* (Gundlach, 1861)**
Figure 3J

New records. NICARAGUA – **Dept. Carazo** • City of Santa Teresa; 11.8033; −086.1644; 20.V.2015; elev. 406 m; ; FAR, JGMF obs.; FA 59 mm; 28 g; found roosting under the roof of a building; 1♂ • Same locality and date; FA 61 mm; 33 g; 1♀ • Same locality and date; FA 59 mm; 28 g; 1♀ – **Dept. Rivas** • El Ostional; 11.11435, −085.7578; elev. 17 m; 20.V.2015; CLC, JGMF obs.; FA 58 mm; 30 g; 1♀ • Same locality and date; FA 60 mm; FA 40 g; 1♀ • Same locality; 31.V.2015; FA 57 mm; 35.5 g; 1♀.

Identification. Our individuals were large, molossid bats with prominent ears. *Eumops ferox* is smaller than *E. underwoodi* Goodwin, 1940 but similar in size to *E. auripendulus* Shaw, 1800, and it can be distinguished by white at the base of the hair, ears that do not reach the tip of the nose when laid forward, long bristles at rump, and a square and broad tragus (Reid 2009; Taylor et al. 2019).

Distribution. This free-tailed bat was previously known in Nicaragua from only two sites in the north, the departments of Madriz and Matagalpa (Medina-Fitoria 2014). Our records from Carazo are the first known roost for this species in Nicaragua. The roost was located in a human structure and the composition of the group we captured suggested it was a harem, as has been noted in other parts of its range (Best et al. 1997). These are the first records of the species for the Pacific region of Nicaragua.

***Eumops underwoodi* Goodwin, 1940**
Figure 3K

New records. NICARAGUA – **Dept. Rivas** • El Ostional; 11.1143, −085.7578; elev. 17 m; 31.V.2015; CLC, JGMF obs.; FA 70 mm; 84 g; 1♀ • Same locality and date; FA 72 mm; 74 g; 1♀.

Identification. A very large bat with prominent ears that, when laid forward, reach the snout. Our individuals were easily distinguished because *E. underwoodi* Goodwin, 1940 is the largest free-tailed bat species in Central America. The most similar in size is *E. perotis* Schinz, 1821 from which it can be distinguished by the presence of long bristle hairs on its rump (Taylor et al. 2019).

Distribution. This species was previously known from only two sites in the Central Highlands and Pacific Lowlands of Nicaragua (Dolan and Carter 1979; Medina-Fitoria 2014). Our records represent a new locality for this species in the country.

***Promops centralis* Thomas, 1915**
Figure 3L

New records. NICARAGUA – **Dept. Carazo** • Barrio Marlon Alvarado; 11.8184; −086.1589; elev. 437 m; 06.VI.2013; JGMF, LEGL obs.; FA 54 mm; 21 g; 1♀ • Same locality and date; FA 53 mm; 20 g; 1♀ • Same locality and date; FA 57 mm; 24 g; 1♂ – **Dept. Granada** • Malacatoya; 12.1178, −086.8850; elev. 40 m; 25.V.2014; JGMF, LEGL obs.; FA 56 mm; 22 g; 1♂.

Identification. Moderately large individuals with small ears and reddish brown, thick, velvety fur. The most similar species are those within the genus *Molossus* É. Geoffroy, 1805, from which it can be distinguished

by the absence of bristle rump hairs and presence of slightly protruding upper incisors in front of the canines (Reid 2009; Taylor et al. 2019).

Distribution. This species was previously known from only one site in San Juan del Sur, Rivas Department (Baker 1975). These records represent the second and third known localities for this species.

Family Vespertilionidae

***Dasypterus ega* (Gervais, 1856)**
Figure 4A

New records. NICARAGUA – **Dept. Rivas** • El Ostional; 11.1143, −085.7578; elev. 17 m; 31.V.2015; JGMF obs.; FA 44 mm; 14.5 g; 1♀ • Same locality and date; FA 49 mm; 16.5 g; 1♀ • Same locality; JGMF obs.; 05.VIII.2015; FA 43 mm; 7 g; 1♂ – **Dept. Nueva Segovia** • Mogotón; 13.6913; −086.3626; elev. 876 m; 8.II.2023; CLC, JGMF, LEGL, MAFM obs.; 20:00; FA 44 mm; 10 g; 1♂ • Same locality and date; 20:00; FA 44 mm; 11 g; 1♂.

Identification. Medium-sized bat, identifiable by its thickly-haired tail membrane, which is densely covered for approximately half its length. Our individuals were distinguishable by their long, vibrant yellow fur and pinkish face and ears. The most similar species is *D. intermedius* (H. Allen, 1862), which is almost identical and can only be distinguished in the field by size (Reid 2009; Moratelli et al. 2019).

Distribution. This species was caught in Nicaragua for the first time in 2003 in the BOSAWAS biosphere reserve in the Central Highlands of the country and later in Chontales in 2013 (Medina et al. 2015). These

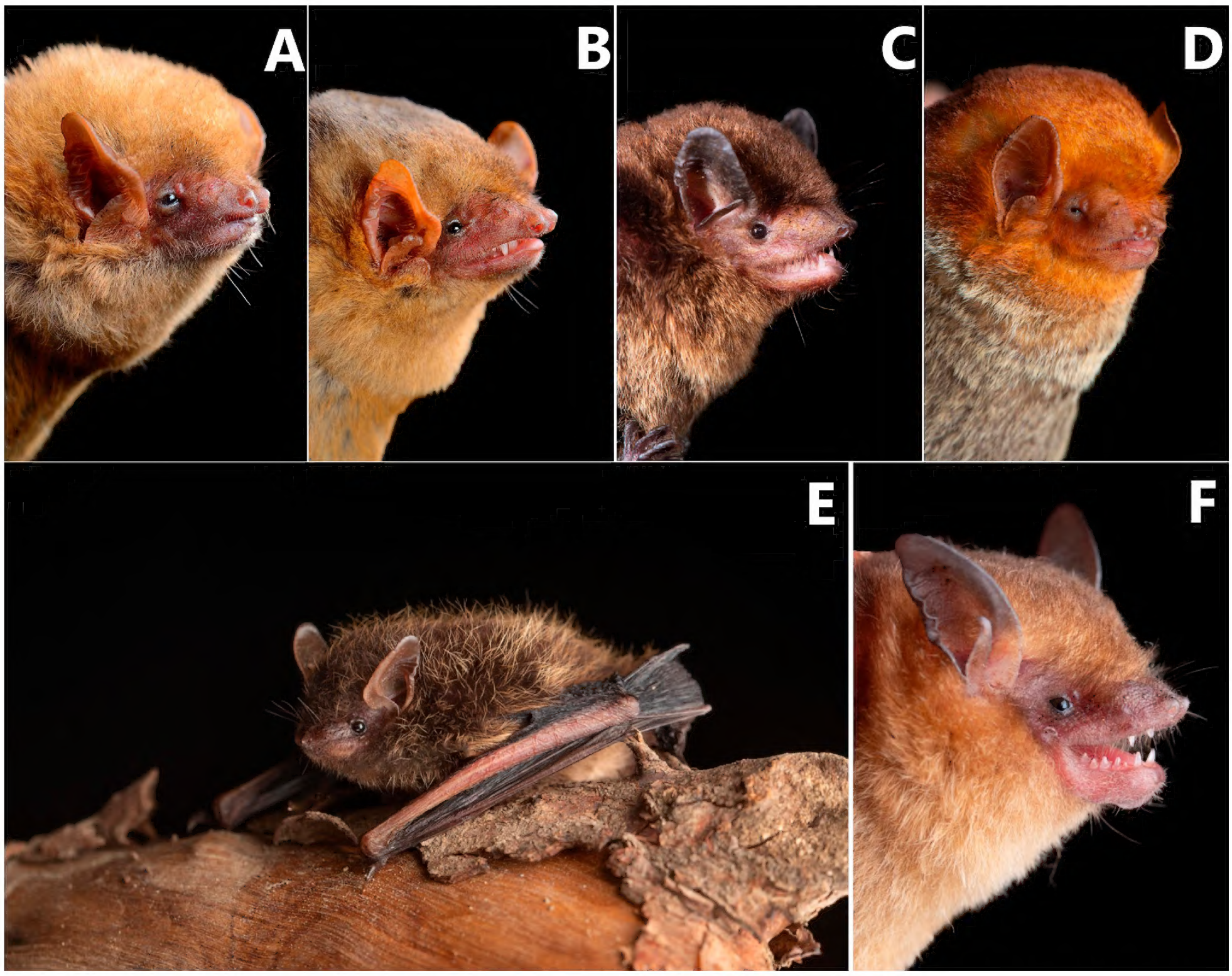

Figure 4. Noteworthy records of Vespertilionidae. **A.** *Dasypterus ega* (Gervais, 1856) from El Ostional. **B.** *Dasypterus intermedius* (H. Allen, 1862) from El Ostional. **C.** *Eptesicus brasiliensis* (Desmarest, 1819) from La Bastilla Ecolodge. **D.** *Lasiurus frantzii* (Peters, 1871) from El Jaguar. **E.** *Perimyotis subflavus* (F. Cuvier, 1823) from Mogotón. **F.** *Rhogeessa io* Thomas, 1903 from Puente Rio Wawa.

individuals represent the third and fourth known locality in the country and the first in the Pacific Lowlands.

Remarks. This species is sometimes included within the genus *Lasiurus* Gray, 1831 (Baird et al. 2015; Moratelli et al. 2019; Martínez-Fonseca et al. 2020).

***Dasypterus intermedius* (H. Allen, 1862)**
Figure 4B

New records. NICARAGUA – **Dept. Nueva Segovia** • Mogotón; 13.6913; −086.3626; elev. 876 m; 8.II.2023; CLC, JGMF, LEGL, MAFM obs.; 18:50; 54 mm; 20 g; 1♂ • Same locality and date; 19:05; FA 52 mm; 22 g; 1♂ • Same locality and date; 19:15; FA 53 mm; 23 g; 1♂ – **Dept. Rivas** • El Ostional; 11.1143; −085.7578; elev. 17 m; 05.VIII.2015; JGMF obs.; FA 55 mm; 22 g; 1♂.

Identification. *Dasypterus intermedius* closely resembles *D. ega* (Gervais, 1856) but is distinguished by its larger size with non-overlapping forearm measurements (Reid 2009, Moratelli et al. 2019).

Distribution. The first record of this species was a dead male specimen found near the south shore of Lake Nicaragua in 2013 (Medina-Fitoria et al. 2015). These records constitute the first live specimen and the second and third localities for *D. intermedius* (H. Allen, 1862) in the country.

***Eptesicus brasiliensis* (Desmarest, 1819)**
Figure 4C

New records. NICARAGUA – **Dept. Rio San Juan** • El Tule; 11.3371, −084.7609; elev. 50 m; 02.IV.2014; JGMF, LEGL obs.; FA 43 mm; 12 g; 1♂ – **Dept. Jinotega** • La Bastilla Ecolodge; 13.1452, −085.8888; elev. 1,202 m; 15.XII.2017; CH, JGMF obs.; FA 41 mm; 11 g; 14:45 captured by hand outside of a crevice in a wooden support of a balcony; the animal was presumably warming up in the sunlight after rain and relatively cool weather; air temperature at time of capture was 15 °C; 1♂.

Identification. Our individuals were easily differentiated from the other species present in the area within the same genus and range, *E. furinalis* D'Orbigny & Gervais, 1847 and *E. fuscus* (Beauvois, 1796). *E. furinalis* D'Orbigny & Gervais, 1847 usually has a shorter forearm length (37 to 41 mm) and shorter hair on the back (<6 mm). *Eptesicus fuscus* (Beauvois, 1796) has the largest forearm starting at 46 mm (Reid 2009). Both of our individuals had hair on the back that was 8 mm in length.

Distribution. This species was recorded in Nicaragua for the first time by Medina-Fitoria et al. (2015) from a locality in the relatively humid lowlands on the north side of Nicaragua (Cocibolca) Lake. Our records confirm the species in the country and represent a new elevation record within Nicaragua and an extension northward for the global distribution for the species.

***Lasiurus frantzii* (Peters, 1871)**
Figure 4D

New records. NICARAGUA – **Dept. Jinotega** • San Rafael del Norte; Reserva Silvestre Privada El Jaguar; 13.2341, −086.0532; elev. 1,275 m; 14.II.2015; FAR, JGMF obs.; FA 37 mm; 1♀ – **Dept. Nueva Segovia** • Mogotón; 13.6913; −086.3626; elev. 876 m; 8.II.2023; CLC, JGMF, LEGL, MAFM obs.; 18:50; FA 37 mm; 1♂ – **Dept. Rivas** • El Ostional; 11.1143, −085.7578; elev. 17 m; 21.V.2015; CLC; JGMF obs.; FA 37 mm; 10 g; 1♀ • Same locality and date; FA 40 mm; 10 g; 1♀ • Same locality and date; FA 40 mm; 10 g: 1♀ • Same locality and date; FA 38 mm; 8 g; 1♀ lactating• Same locality and date; FA 44 mm; 10 g; 1♀ gravid • Sardina River; 11.1288, -085.3106; elev. 52 m; 10.VII.2015; JGMF obs.; FA 40 mm; 9 g; 1♀.

Identification. A relatively small species, our individuals were easily identified by the characteristic long and thick fur with vibrant orange-red coloration. This species has white patches on its shoulders and a thickly haired tail membrane, which is densely covered with reddish fur almost to the tip of tail. The most similar species is *L. egregius* (Peters, 1870) which is much larger and rare; it has never been reported in Nicaragua (Reid 2009; Moratelli et al. 2019).

Distribution. There are relatively few records across Central America and only five localities in Nicaragua (Reid 2009; Medina-Fitoria 2014). This species was known in Nicaragua from a few specimens from the southern Caribbean Lowlands and the central Pacific Lowlands (Medina-Fitoria 2014). Our records are new localities for the species. Nicaraguan and Central American populations were formerly included under *L. blossevillii* (Lesson and Garnot, 1826) (Baird et al. 2015; Moratelli et al. 2019).

***Perimyotis subflavus* (F. Cuvier, 1823)**
Figure 4E

New record. NICARAGUA – **Dept. Nueva Segovia** • Mogotón; 13.6913; −086.3626; elev. 876 m; 8.II.2023; CLC, JGMF, LEGL, MAFM obs.; 18:15; FA 32 mm; 4 g; 1♂.

Identification. Our individual was identified as this species by its broad tragus with rounded tip and the distinct tricolored hairs that were dark at the base, yellowish in the middle band, and buffy at the hair tips (Fujita and Kunz 1984, Reid 2009). The tail membrane was also distinctive, with sparse yellow hairs from the base to below the knee (Reid 2009).

Remarks. This species was previously recorded in Nicaragua from a single individual by Medina-Fitoria et al. (2015) about 40 km southwest of our specimen in Somoto Canyon, Department of Madriz. The species varies in dorsal color from pale yellow-orange to dark reddish-brown in the United States and the southern populations also differ in color (Fujita and Kunz 1984; Reid 2009).

***Rhogeessa io* Thomas, 1903**
Figure 4F

New records. NICARAGUA – **Dept. Rio San Juan** • Rio Papaturro; 11.0489; −085.0534; elev. 36 m; 21.V.2014; JGMF, LEGL obs.; FA 32 mm; 6.5 g; 1♂ – **Región Autónoma Costa Caribe Norte** • Puente Rio Wawa; 14.121, −083.544; elev. 12 m; 28.VII.2022; JCLM, JGMF, MAFM obs.; FA 32 mm; 5 g; 1♂.

Identification. *Rhogeessa io* is a very small bat; our individuals matched descriptions for this species with a distinctively tricolored dorsal fur pattern, featuring dark brown at base and tips. Our individuals can be further distinguished from other congeneric species (*R. bickhami* Baird, Marchán-Rivadeneira, Pérez & Baker, 2012) by their larger size and darker coloration (Reid 2009; Moratelli et al. 2019).

Remarks. Thomas's yellow bat is a species known only from a few individuals recorded in the southeast region around Lake Nicaragua, near the Costa Rican border (Medina-Fitoria et al. 2010). These records are noteworthy because of the paucity of specimens known from Nicaragua of this species.

Order Rodentia
Family Geomyidae

***Heterogeomys cherriei matagalpae* J. A. Allen, 1910**
Figure 5A, B

New record. NICARAGUA – **Dept. Jinotega** • San Rafael del Norte; Reserva Silvestre Privada El Jaguar; 13.2341, −086.0532; elev. 1,275 m; 23.III.2014; FAR, JGMF obs.; around 22:30; caught by hand when found foraging and actively moving above ground in short grass on the side of an access road, it was not evident from which burrow it emerged; 1♂.

Identification. Our individual was easily recognized as belonging to this species by the blackish body color contrasting with a white patch on the top of the head (Reid 2009). The only other pocket gopher species in Nicaragua, *Orthogeomys grandis* (Thomas, 1893), is much larger, has a reddish-brown body color, and lacks the distinctive white patch on the head (Reid 2009; Medina-Fitoria and Saldaña Tapia 2012).

Remarks. This species is sometimes included in the genus *Orthogeomys* Merriam, 1895 (Reid 2009). Isolated populations in northern Nicaragua and Honduras were also considered a different species (Spradling et al. 2016). To our knowledge, our photos are the only ones taken of a live individual in Nicaragua.

Order Carnivora
Family Mustelidae

***Galictis vittata* (Schreber, 1776)**
Figure 5C

New record. NICARAGUA – **Región Autónoma Costa Caribe Norte** • Finca Cacao Oro; 14.0894 −084.2060; elev. 71 m; 16.III.2023; JCLM obs.; actively digging a burrow at 14:26.

Identification. The greater grison is readily distinguished by its distinctive black and white color pattern. No other mustelid in Central America has a white line across the forehead to ears and down its neck with an overall gray body (Reid 2009).

Remarks. This species is rarely seen and very few reports (all unconfirmed) have been made from mostly mature forest remnants in the central and southern Caribbean Lowlands. We did not find museum records of the species in Nicaragua or other material with specific localities (GBIF 2023).

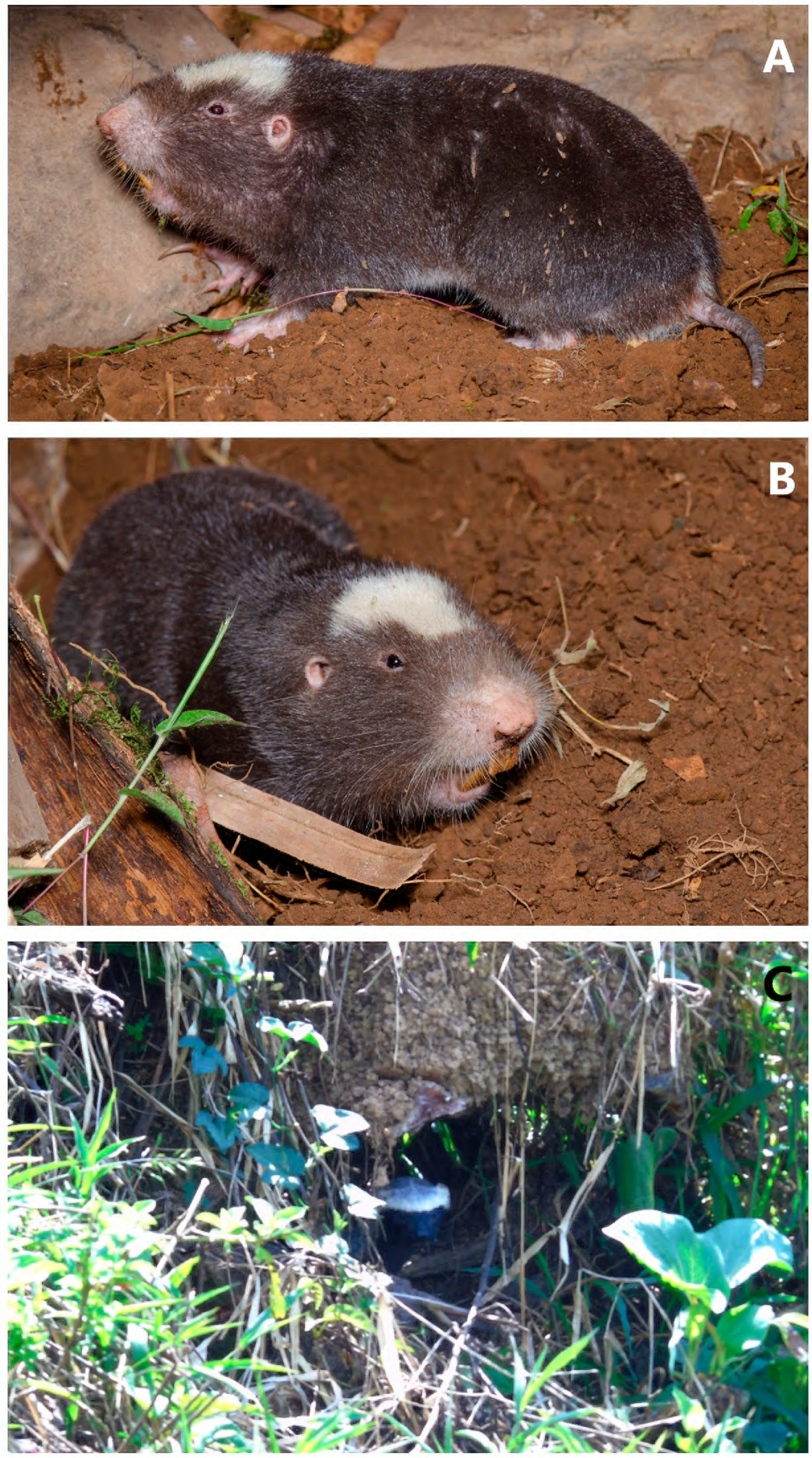

Figure 5. Noteworthy records of Geomyidae and Mustelidae. **A, B.** *Heterogeomys cherriei matagalpae*. J.A. Allen, 1910 from El Jaguar. **C.** *Galictis vittata* (Schreber, 1776) from Finca Cacao Oro.

DISCUSSION

Our work fills gaps in the known distributions of mammal species in Nicaragua and highlights the importance of departmentally and privately-owned natural reserves for the conservation of habitat for these relatively rare species. We reported range extensions and new departmental records for 12 species. As noted in recent works like Araque Pérez (2023), the Caribbean Lowlands and the northeastern region of the country is dramatically underrepresented and under sampled, not just for mammals, but across all taxonomic groups.

Many species of bats, including *Cynomops mexicanus* Jones & Genoways, 1967, *Diclidurus albus* Wied-Neuwied, 1820, *Eumops auripendulus* Shaw, 1800, *E. nanus* Miller, 1900, *Furipterus horrens* (F. Cuvier, 1828), *Leptonycteris yerbabuenae* Martinez & Villa, 1940, *Mesophylla macconelli* Thomas, 1901, *Mimon cozumelae* Goldman, 1914, *Perimyotis subflavus* (F. Cuvier, 1832), *Rhogeessa permutandis* Baird, Light, & Bickham, 2019, *Molossus aztecus* Saussure, 1860, *Nyctinomops laticaudatus* É. Geoffroy, 1805, *Thyroptera discifera* Lichtenstein & Peters, 1855, and *Sturnira luisi* Davis, 1980 are known to occur in Nicaragua from a

single or just a few localities (Loza et al. 2018; Baird et al. 2019; Medina-Fitoria and Martínez-Fonseca 2019; Martínez-Fonseca et al. 2020; Saldaña Tapia et al. 2020). We expect that the adoption of acoustic monitoring devices and the expansion of research to new areas will improve our knowledge of bat distributions across the country. Likewise, other survey methods for terrestrial mammals, such as camera trapping, will likely also increase data for other taxa.

By sharing locality information for common and rare species in understudied regions, we can improve our understanding of species occurrence, distribution, and ties to environmental conditions (Kéry 2009). This can have significant benefits for conservation and management of important biodiversity sites (Spear et al. 2023). Further, this work clarifies the status of some species in the country that until now could be interpreted as accidental (e.g., *P. subflavus* (F. Cuvier, 1832)). This is important for Nicaragua and many other countries in Latin America for which the faunae are understudied or underreported.

ACKNOWLEDGMENTS

This work is dedicated to the memory of Arnulfo Medina-Fitoria (1974–2022), a Nicaraguan mammalogist. We thank the Ministerio de Ambiente y Recursos Naturales, Programa para la Conservación de Murciélagos de Nicaragua (PCMN), and Paso Pacifico for logistical support and research permits. We also thank team members Annika Keeley, Bryan Keeley, William Noble, Erin Saunders, Kimberly Williams-Guillén, and Kei Yasuda for their help in the field. Thanks are given as well to Liliana Chavarría-Duriaux, Georges Duriaux, and Lenin Obando, for granting access to their properties for sampling. Finally, we want to thank Guilherme Garbino, Filipe Gudinho, Reid Miller, and anonymous reviewers for their comments and suggestions that improved the quality of this manuscript.

ADDITIONAL INFORMATION

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement is reported.

Funding

Fieldwork for this manuscript was partially funded by a Student Scholarship from Bat Conservation International, as well with support for expeditions provided by Paul Carter, Jon Hall, and Mike Richardson.

Author contributions

Conceptualization: CLC, JGMF. Data curation: JGMF. Formal analysis: JGMF. Investigation: CLC, CH, EPW, LAT, LEGL, FAR, JCML, JGMF, MAFM. Supervision: CLC, FAR. Visualization: JCLM, JGMF. Writing – original draft: JGMF, LAT. Writing – review and editing: CLC, EPW, JGMF.

Author ORCID iDs

José Gabriel Martínez-Fonseca https://orcid.org/0000-0002-3181-2525
Luis A. Trujillo https://orcid.org/0000-0001-8364-6189
Erin P. Westeen https://orcid.org/0000-0001-7685-4588
Carol L. Chambers https://orcid.org/0000-0002-2524-4672
Maynor A. Fernández-Mena https://orcid.org/0009-0007-8726-9158
Luis E. Gutiérrez-López https://orcid.org/0009-0002-3777-4109

Data availability

All data that support the findings of this study are available in the main text.

References

Allen JA (1910) Additional mammals from Nicaragua. Bulletin American Museum of Natural History XXIV: 87–115.

Araque Pérez J (2023) Contribución para el conocimiento en la distribución de fauna terrestre de Nicaragua. Revista Nicaragüense de Biodiversidad 93: 1–45.

Arroyo-Cabrales J, Owen RD (1997) *Enchisthenes hartii*. Mammalian Species 546: 1–4.

Baird A, Light JE, Bickham J (2019) A New Species of *Rhogeessa* from Nicaragua based on morphological, karyotypic, and molecular data. Special Publications, Museum of Texas Tech University 71: 257–273.

Baird AB, Braun JK, Mares MA, Morales JC, Patton JC, Ran CQT, Bickham JW (2015) Molecular systematic revision of tree bats (Lasiurini): Doubling the native mammals of the Hawaiian Islands. Journal of Mammalogy 96: 1255–1274. https://doi.org/10.1093/jmammal/gyv135

Baker RJ, Knox Jones JJ (1975) Additional records of bats from Nicaragua with a revised checklist of Chiroptera. Occasional Papers of the Museum of Texas Tech University: 1–13.

Burgin CJ, Colella JP, Kahn PL, Upham NS (2018) How many species of mammals are there? Journal of Mammalogy 99: 1–14. https://doi.org/10.1093/jmammal/gyx147

Fujita BMS, Kunz TH (1984) *Pipistrellus subflavus*. Mammalian Species 228: 1–6.

GBIF.Org (2023) Occurrence download. https://doi.org/10.15468/DL.SPR4NX

Greenbaum IF, Knox Jones JJ (1978) Noteworthy records of bats from El Salvador, Honduras, and Nicaragua. Occasional Papers of the Museum of Texas Tech University 55: 1–6.

Incer J (1973) Geografía Ilustrada de Nicaragua. Editorial Recalde, Managua, Nicaragua, 280 pp.

Jones JK, Homan JA (1974) *Hylonycteris underwoodi*. Mammalian Species 32: 1–2. Available from: https://academic.oup.com/mspecies/article/doi/10.2307/3504417/2600756.

Jones JKJ, Owen RD (1986) Checklist and bibliography of Nicaraguan chiroptera. Occasional Papers of the Museum of Texas Tech University 106: 1–13.

Kéry M (2009) Towards the modelling of true species distributions. Journal of Biogeography 38: 617–618. https://doi.org/10.1111/j.1365-2699.2011.02487.x

Kunz TH, Parsons S (2009) Ecological and behavioral methods for the study of bats. Second edition. Johns Hopkins University Press, Baltimore, USA, 920 pp.

Loza J, Sunyer J, Reid FA, Martínez-Fonseca JG (2018) First capture of *Diclidurus albus* wied-neuwied, 1820 (Mammalia, chiroptera, Emballonuridae) from Nicaragua. Check List 14: 1021–1025. https://doi.org/10.15560/14.6.1021

Martínez-Cerón JM, Patiño-Castillo E, Carvalho-Madrigal S, Díaz-Nieto JF (2019) Molecular and morphological identification of *Phylloderma stenops* Peters, 1865 (Chiroptera, Phyllostomidae) and new records for Colombia. Check List 15: 37–44. https://doi.org/10.15560/15.1.37

Martínez-Fonseca JG, Medina-Fitoria A, Westeen EP, Chambers CL (2020) Revised checklist of the bats (Mammalia: Chiroptera) of Nicaragua. Occasional Papers of the Museum of Texas Tech University 369: 1–36.

Martínez-Fonseca JG, Mau R, Walker FM, Medina-Fitoria A, Yasuda K, Chambers CL (2022) *Vampyrum spectrum* (Phyllostomidae) movement and prey revealed by radio-telemetry and DNA metabarcoding. PLoS ONE 17: 1–13. https://doi.org/10.1371/journal.pone.0265968

Medina-Fitoria A (2014) Murciélagos de Nicaragua: Guía de campo. Programa para la Conservación de los Murciélagos de Nicaragua (PCMN) y Ministerio del Ambiente y los Recursos Naturales (MARENA), Managua, Nicaragua, 279 pp.

Medina-Fitoria A, Saldaña Tapia OA (2012) Lista patrón de los mamíferos de Nicaragua. FUNDAR, Managua, Nicaragua, 40 pp.

Medina-Fitoria A, Saldaña O (2014) Historia de la mastozoología en Nicaragua: una retrospectiva sobre la investgación en el país y su futuro. In: Ortega, Martínez, Tirira (Eds.), Historia de la Maztozoología en Latinoamerica, las Guyanas y el Caribe. Editorial Murciélago Blanco, Quito, Ecuador, 315–328.

Medina-Fitoria A, Martínez-Fonseca JG (2019) Cronología histórica de la quiropterología en Nicaragua. Revista Mexicana de Mastozoología, nueva época 9: 1–28.

Medina-Fitoria A, Martínez-Fonseca JG (2021) Revisión histórica de los mamíferos silvestres de la región biogeográfica del pacífico nicaragüense. Revista Mexicana de Mastozoología, nueva época 11: 15–40.

Medina-Fitoria A, Saldaña O, Martínez JG, Aguirre Y, Silva W, Chávez M, Salazar M, Carballo N, Jarquín O, González RA, Díaz L, Chambers C, Reid F, Mies R, Williams K, Zolotoff JM, Molina C, Pérez T, Rodríguez J, Gutiérrez L, Fernández M, Mendieta R, Pérez J (2015) Nuevos reportes sobre los murciélagos (Mammalia: Chiroptera) de Nicaragua, América Central, con la adición de siete nuevos registros de especies. Mastozoología Neotropical 22: 43–54.

Medina-Fitoria A, Saldaña O, MacCarthy T, Vílchez S (2010) Nuevos reportes y comentarios históricos de Murciélagos (Orden Chiroptera) para la fauna de Nicaragua. Biodiversidad Revista Nicaragüense 2: 93–102.

Moratelli R, Burgin CJ, Novaes RLM, López-Baucells A, Haslauer R (2019) Family Vespertilionidae. In: Wilson, Mittermeier (Eds.), Handbook of the mammals of the world Vol. 9. Lynx Edicions, Barcelona, 716–982.

Ramírez-Fernández JD, Sánchez R, May-Collado LJ, González-Maya JF, Rodríguez-Herrera B (2023) Revised checklist and conservation status of the mammals of Costa Rica. Therya 14: 233–244. https://doi.org/10.12933/therya-23-2142

Reid FA (2009) A field guide to the mammals of Southeast Mexico and Central America. 2nd ed. Oxford University Press, New York, USA, 346 pp.

Saldaña Tapia OA, Ñamendy M, Martínez-Fonseca JG (2020) First record of the lesser long-nosed bat, *Leptonycteris yerbabuenae* Martinez & Villa-r., 1940 (Chiroptera, Phyllostomidae), in Nicaragua. Check List 16: 451–456. https://doi.org/10.15560/16.2.451

Sikes RS, the Animal Care and Use Committee of the American Society of Mammalogist (2016) 2016 Guidelines of the American Society of Mammalogists for the use of wild mammals in research and education. Journal of Mammalogy 97: 663–688. https://doi.org/10.1093/jmammal/gyw078

Simmons NB, Cirranello AL (2023) Bat species of the world: A taxonomic and geographic database Version 1.3. Available from: https://batnames.org/home.html.

Spear D, van Wilgen NJ, Rebelo AG, Botha JM (2023) Collating biodiversity occurrence data for conservation. Frontiers in Ecology and Evolution 11: 1–6. https://doi.org/10.3389/fevo.2023.1037282

Spradling TA, Demastes JW, Hafner DJ, Milbach PL, Cervantes FA, Hafner MS (2016) Systematic revision of the pocket gopher genus *Orthogeomys*. Journal of Mammalogy 97: 405–423. https://doi.org/10.1093/jmammal/gyv185

Sunyer J (2009) Taxonomy, zoogeography, and conservation of the herpetofauna of Nicaragua. Doctoral Thesis. Goethe-Universität, Frankfurt, Germany, 281pp. Available from: http://core.ac.uk/download/pdf/14507040.pdf.

Taylor P, Lim B, Pennay M, Soisook P, Kingston T, Loureiro L, Moras L (2019) Family Molossidae. In: Wilson, Mittermeier (Eds.), Handbook of the mammals of the world Vol. 9. Lynx Edicions, Barcelona, 598–672.

Timm RM (1982) *Ectophylla alba*. Mammalian Species 166: 1–4.

Trujillo LA, Escobar-Anleu BI (2023) First record of the genus *Metachirus* in Guatemala Primer registro del género *Metachirus* en Guatemala. Therya notes 4: 97–100. https://doi.org/10.12933/therya_notes-23-113

Velazco PM, Simmons NB (2011) Systematics and taxonomy of great striped-faced bats of the genus *Vampyrodes*. American Museum Novitates: 1–36. https://doi.org/doi.org/10.1206/3710.2

Voss A, Robert S, David W, Sharon A (2019) Mammalian diversity and Matses Ethnomammalogy in. Bulletin of the American Museum of Natural History 432: 1–90.

Voss RS (2022) An annotated checklist of recent opossums (Mammalia: Didelphidae). Bulletin of the American Museum of Natural History 455: 1–76. https://doi.org/10.1206/0003-0090.455.1.1

Voss RS, Giarla TC, Jansa SA (2021) A revision of the didelphid marsupial genus *Marmosa* part 4. Species of the *Alstoni* group (subgenus *Micoureus*). American Museum Novitates 2021: 1–32. https://doi.org/10.1206/3983.1

York HA, Rodríguez-Herrera B, LaVal RK, Timm RM, Lindsay KE (2019) Field key to the bats of Costa Rica and Nicaragua. Journal of Mammalogy 100: 1726–1749. https://doi.org/10.1093/jmammal/gyz150

Zamora-Gutierrez V, Ortega J (2020) *Lichonycteris obscura* (Chiroptera: Phyllostomidae). Mammalian Species 52: 165–172. https://doi.org/10.1093/mspecies/seaa012